

# Introducing assistive robots in ambient assisted living (AAL) environments

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## 1. Introduction/Context

The field of assistive robotics was defined, in the past, by a robot capable of assisting people with physical disabilities or limited mobility through physical interaction [1]. In time, the world of robotics became more and more influential, with new and improved capabilities, offering not only physical assistance, but also the ability to socialize and understand the needs of the person requiring care. This is how the field of socially assistive robots began to rise and more and more robots with social capabilities were developed.

Pepper<sup>1</sup> is a humanoid robot with a friendly aspect which makes it suitable for social tasks and human interactions. It is equipped with multiple sensors and specialized hardware for motion and perception, having a 3D camera and a tablet for displaying information.

Having Pepper in an ambient assistive living environment can enhance the social user experience. The robot can access the information from the IoT devices which are part of the ambient intelligent environment and can interact with the various actuators. Due to the fact that the robot is integrated in the environment, it can also provide additional information back to the environment.

The proposed solutions will be focused on integrating information from various devices in a context aware environment [2] and the interactions between users and devices.

## 2. Objective

The main objective is to create a platform for developing robotic applications with Pepper which will interact with a smart environment and will make use of the information in order to enhance the user experience.

The following is a concrete list of tasks expected to be achieved as part of this research proposal:

1. Enhance the SPARC [3] and CAMI [4] frameworks with extended input/output and interaction capabilities
  - Telepresence system - The robot must be able to help the user communicate with the caregiver in case of an emergency
  - Interaction with the environment - The robot must be able to interact with the environment when receiving commands from the user or when the robot finds it suitable

1 <https://www.softbankrobotics.com/emea/en/robots/pepper>

- Data acquisition - The robot must be able to offer useful information on demand
2. Replace the planning module of the SPARC framework with a more sophisticated one, capable of receiving information from the environment and trigger more complex behaviours.
  3. Extend the CAMI framework in order to provide information back to Pepper, like the location of the user based on the IoT network, the last known activity based on the activity recognition module etc.

#### Milestone 1

- Research on state of the art technologies used for ambient assisted living environments
- Get accustomed to working with Pepper, the SPARC and CAMI frameworks
- Designing an architecture that will incorporate parts of the SPARC and CAMI frameworks.
- Integrate new sensors and actuators inside the Aml environment

#### Milestone 2

- Extend the CAMI framework and enhance the current capabilities of the robot in order to be able to interact with it
- Create a multi-modal interface capable of voice, touch and other meaningful interactions with Pepper that will enhance the user experience [5]

#### Milestone 3

- Finish up the system
- Gather results that will prove that the proposed solution is suitable for the elderly users

### 3. Required and Learned Skills

#### Requirements:

- Familiarized with RESTful API
- Adequate programming experience in Python
- Experience with HTML, CSS, Node JS or other web design frameworks is a plus
- Basic machine learning knowledge is a plus

#### Skills learned:

- Experience in working with web technologies
- Experience in working with humanoid robots
- Learning how to use machine learning techniques and models to solve ambient assistive living tasks

### 4. References

[1] David Feil-Seifer and Maja J. Matarić. Defining socially assistive robotics. Proceedings of the 2005 IEEE 9th International Conference on Rehabilitation Robotics, 2005(July 2005):465–468, 2005

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[3] SPARC System - <https://sparc.readthedocs.io/en/latest/>, last accessed 27.09.2018

[4] CAMI System - <http://www.camiproject.eu/> last accessed 27.09.2018

[5] A. F. Gavril, M. Trascau and I. Mocanu, "Multimodal Interface for Ambient Assisted Living," 2017 21st International Conference on Control Systems and Computer Science (CSCS), Bucharest, 2017, pp. 223-230.

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